(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 518 916 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
30.07.1997 Bulletin 1997/31

(21) Application number: **91905145.8**

(22) Date of filing: **21.02.1991**

(51) Int Cl.[6]: **G08C 19/06**

(86) International application number:
PCT/US91/01210

(87) International publication number:
WO 91/13417 (05.09.1991 Gazette 1991/21)

(54) **MULTIFUNCTION ISOLATION TRANSFORMER**

MEHRFUNKTIONSISOLATIONSTRANSFORMATOR

TRANSFORMATEUR D'ISOLEMENT MULTIFONCTIONS

(84) Designated Contracting States:
DE FR GB

(30) Priority: **21.02.1990 US 483062**

(43) Date of publication of application:
23.12.1992 Bulletin 1992/52

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Description

BACKGROUND OF THE INVENTION

This invention relates to a transmitter having loop circuitry receiving energization from a current loop and controlling the loop current to represent a parameter sensed by sensor circuitry in the transmitter.

In transmitter circuits, a galvanic barrier is often desired between loop circuitry and sensor circuitry in order to block flow of undesirable ground currents through sensitive transmitter circuits. Magnetic transformers and optocouplers have been used to couple signals and power between isolated circuits on opposite sides of the barrier, while providing DC isolation between them. Typically, the loop circuitry couples energization across the barrier to energize the sensor circuitry while the sensor circuitry returns a sensor signal indicating the sensed parameter back across the barrier to the loop circuitry. In U.S. Patents 3,764,880 and 4,206,397, for example, a single transformer provides galvanic isolation between a circuit connected to a loop and sensor circuitry. The single transformer couples energization in one direction and a sensor signal in an opposite direction across the barrier.

U.S. Patent 4,758,836 describes a bi-directional, digital data transmission system having a transformer coupling signals between an interrogation unit and a transponder unit. The system operates in two modes. The first mode is broken into two intervals. During the first interval, the interrogation unit transmits an interrogation signal to the transponder. During the second interval, utility data in the transponder is transmitted back to the interrogator. In the second mode of operation, program information provided by the interrogator is transmitted to the transponder.

Other circuits, such as described in U.S. Patents Nos. 4,333,072 and 4,941,201 utilize bi-directional data communication and energization through electrically insulating couplers.

Transmitters can be of a programmable type, programmed by a digital signal from a programming device connected to the loop. For each installation, there is a desire to adjust or program the transmitter to have an output range and other characteristics match the installation. In some transmitter arrangements, it is desirable to have the transmitter's sensor circuitry be programmable so that that sensing is specifically adapted to the range of the input variable of interest in a particular installation. However, the digital programming signals generated on the loop side of the galvanic barrier must be kept isolated from the sensor circuitry which is to be programmed on the other side of the barrier. There is thus a need to couple digital programming signals across the barrier, leading to an apparent need for another galvanically isolating coupling device to be added to the transmitter. Digital sensor circuitry typically would also require a timing reference or clock for support of its functions, and there is further a desire to have a single clock supporting circuitry on both sides of the barrier, leading to an apparent need for yet another galvanically isolating coupling device such as a transformer or optical coupler. Each additional coupling device can increase complexity and power consumption, which can be limited when the transmitter is energized by a milliampere level loop current such as a 4-20 mA loop current.

There is thus a desire to provide a transmitter which provides galvanically isolated coupling of energization, a signal representative of the sensed parameter, a timing reference, and a programming signal across a barrier, but avoiding the cost, complexity and increased power consumption of adding multiple isolating coupling devices.

SUMMARY OF THE INVENTION

According to the present invention there is provided a transmitter providing a transmitter output representing a sensed parameter to a loop which energizes the transmitter, comprising:

an output circuit receiving the energization from the loop and controlling the transmitter output as a function of a sensor data input, the output circuit further generating an oscillating driver output signal including programming data representing programmable instructions;
a sensor circuit generating a clocked sensor data output representing the sensed parameter; and
a single coupling device driven by the oscillating driver output signal for energizing the sensor circuit and for providing a filtered power supply, the programming data for programming the sensor circuit and a clock reference as a function of the oscillating driver output signal to the sensor circuit, and providing the sensor data output back to the sensor data input of the output circuit, the single coupling device simultaneously coupling energization,
the clock reference, and the programming data from the output circuit to the sensor circuit and the sensor data from the sensor circuit to the output circuit across an electrically insulating barrier between the output circuit and the sensor circuit.

A transmitter is provided with a single galvanically insulating coupling device which isolates loop circuitry from sensor circuitry. Transmitter circuitry is arranged to utilize the single coupling device to isolatingly couple not only power and a representation of a sensed parameter, but also programming data simultaneously across a galvanic barrier.

A transmitter sends its output representing a sensed parameter to a loop or circuit which energizes the transmitter. An output circuit in the transmitter receives the energization from the loop and controls the

transmitter output as a function of a sensor data input. The output circuit further generates an oscillating driver output. A sensor circuit generates a sensor data output representing the sensed parameter. Isolation means driven by the driver output excite the sensor circuit and provide a clock reference as a function of the driver output oscillation to the sensor circuit. The isolation means couple the sensor data output back to sensor data input. Isolation means include a single coupling device which couples energization, clock reference, sensor data and programming data across an electrically insulating barrier between the output circuit and the sensor circuit.

In a preferred embodiment, the single coupling device is a magnetic transformer.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a first embodiment of a transmitter according to the invention.

FIG. 2 shows a second embodiment of a transmitter according to the invention.

FIG. 3 shows a transformer circuit corresponding to FIG. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1, a first embodiment of a transmitter according to the invention is shown in block diagram form. In FIG. 1, transmitter 50 is connected to loop 52. Loop 52 can be a two wire 4-20 mA industrial control loop or a "multidrop" loop which supplies current to several transmitters in parallel. A 4 wire type circuit with 2 wires providing energization and two wires providing a 1-5 volt output can be used in place of loop 52, as well. Loop 52 supplies all of the energization to transmitter 50. Transmitter 50 is also coupled to a programming device 54 which can be a Rosemount Brand Model 268 providing programming via two way HART Brand digital communication protocol superimposed on the loop current.

Loop 52 supplies energization to power supply 56 which, in turn, energizes circuitry 60 on the left side of galvanic barrier 58 shown in dashed line form in FIG. 1. Current control 57 is coupled to the loop 52 to control loop current and is coupled to microcomputer 66 to receive instructions. Current control 57 comprises a digital-to-analog current converter circuit. Clock oscillator 62 generates a timing reference or clock which is provided along line 64 to microcomputer 66 and driver circuit 68. Programming device 54 communicates with microcomputer 66 along line 70 to provide programming instructions which are stored in microcomputer 66. Driver circuit 68 generates an oscillatory driver output on line 72 which has a frequency controlled by clock oscillator 62. The output frequency is selected to be high enough so that it can be conveniently amplitude modulated with lower frequency modulations which carry programming data and sensed process parameter data. A drive frequency over 200 kilohertz is desirable to ensure fast enough updating of the transmitter output with process parameter information. A frequency range of 200 - 1000 kilohertz is acceptable for the drive frequency, with a range of 200 - 500 kilohertz being preferred. Driver output on line 72 is coupled to excite primary winding 74 of transformer 76. Microcomputer 66 couples a communication output on line 78 to control switch 80. Control switch 80 modulates the excitation current of transformer primary 74 with a communication signal representing programming instructions to be received by sensor circuit 82. The modulation is preferably amplitude modulation at a frequency lower than the excitation frequency.

Transformer 76 comprises primary winding 74 which is electrically insulated from secondary winding 75. Transformer 76 couples the modulated excitation to secondary 75. Secondary 75 is connected to diode 84 which rectifies the transformed isolated excitation and provides the excitation to filter 86. Filter 86 filters the excitation to extract the modulation provided by switch 80. The modulation is coupled along line 88 to waveshaping circuit 90 which provides further signal conditioning as needed. The output of waveshaper 90 provides the modulation which represents programming instructions to the sensor circuit 82. The sensor circuit 82 stores the programming instructions for programming the operation of the sensor circuit to adapt its characteristics to a particular measurement application. Characteristics such as span, zero, sampling rate, damping, calibration constants, and compensation for extraneous variables can be programmed in the sensor circuit 82 as desired. In the case of transmitters which are adapted in the field to a selected sensor, the programming can also adapt tne sensor circuit to a selected sensor. For example, a temperature transmitter can be programmed to adapt it to different types of thermocouples or resistance temperature detectors (RTD's).

Line 88 also couples excitation to a power supply filter 92 which provides a filtered power supply potential along line 94 to sensor circuit 82. Secondary winding 75 is coupled along line 96 to pulse shaper 98 which, in turn, provides shaped excitation to sensor circuit 82 as a clock or frequency reference. Sensor circuit 82 senses a process parameter 100 which can be temperature, pressure, flow, and the like. Sensor circuit 82 generates a serial digital output representing the process variable conditioned by the programming data stored in it along line 102 to control a switch 104 which modulates the power provided by the secondary winding 75 to circuitry 106 on the right side of the barrier 58. Sense winding 108 of transformer 76 senses the modulation of the power and provides the modulation to microcomputer 66 via waveshaper 110 to provide microcomputer 66 with a signal representative of the sensed parameter adjusted for the programmed data stored in circuit 82. It is not essential that transformer 76 have three windings. Transformer 76 could also be configured with only two winding 74, 75, in which case waveshaper 110 would simply re-

ceive its input from winding 74.

The transformer 76 in FIG. 1 thus is a single isolation device which provides electrically insulated coupling of power, a clock frequency reference, a signal representative of the sensed parameter, and programming instructions, as well. The single transformer 76 of FIG. 1 thus provides galvanic isolation between loop circuitry such as output circuit 60 and sensor circuitry 106. The single transformer 76 not only couples energization and a signal representative of the sensed parameter, but also couples a clock reference and programming signals across the barrier to maintain electrical isolation without providing additional transformers or other isolation devices in the transmitter.

In FIG. 2, a transmitter 150 is coupled to a two wire 4-20 milliampere loop 152 comprising a loop power supply 154 having a limited voltage and a readout device 156. As explained above in connection with FIG. 1, a programming device 158 is connected to the loop to provide programming to the transmitter. The programming device blocks lower frequency 4-20 mA loop current so that it does not interfere with loop operation.

The loop circuit is grounded to a ground system 160 at location 162. There are other electrical devices which are grounded to ground system 160 which inject noise currents i_N into the ground system at points 164. A sensor or sensors 166 are also coupled to ground system 160 at point 168. Because of the noise currents flowing in ground system 160, there is a noise potential difference E_N between points 162 and 168. If transmitter 150 included a completed electric circuit between the loop 152 and the sensors 166, noise ground currents would flow through transmitter 150 and loop 152, disturbing the measurement at readout 156. To avoid this problem, transmitter 150 is provided with a galvanic barrier 170 between circuitry connected to the loop 152 and the sensors 166. The galvanic barrier is an electrical open circuit which blocks electrical noise current flow, but still allows energy and information bearing signals to pass across the barrier using nonelectric transfer means such as the magnetic field of a transformer. Each electrical component which has connections on opposite sides of barrier 170 must be an isolating component. Typically, isolation voltages on the order of 1,000 volts or more are desired. While this explanation of barriers, grounding and ground systems has been explained in connection with FIG. 2, it applies generally to FIG. 1, as well.

In transmitter 150, current control circuit 172 is connected to loop 152 at terminals 174. Current control circuit 172 is energized by current from loop 152 and provides energization along line 176 to other circuits on the left side of barrier 170. Current control 172 controls loop current as a function of a DAC output received on line 178 from DAC 180. Current control circuit 172 passes serial digital communication signals back and forth along line 182 between programming device 158 and MODEM 184. The digital communication signals include programming instructions and constants, for storage in circuitry on the right side of barrier 170. DAC 180 and MODEM 184 communicate along bus 186 with microcomputer 188. Microcomputer 188 provides a digital word representative of a parameter or parameters sensed by sensors 166 to both DAC 180 and MODEM 184. Microcomputer 188 stores programming constants provided by MODEM 184. Clock oscillator 190, which can be a crystal controlled oscillator, provides frequency or clock references to modem 184, microcomputer 188 and driver 192. Regulator 194 is energized by current control circuit 172 and provides a regulated supply potential along line 196 to driver 192.

Driver 192 drives an input of isolation device 198 along line 200 with an energy delivering waveform having a frequency controlled by clock oscillator 190. The driver 192 modulates the waveform with data received on line 202 from microcomputer 188. The modulation represents programming constants for circuitry on the right side of barrier 170. Isolation device 198 electrically isolates lines 200, 204 from lines 206, 208, 209 while providing coupling across the barrier of energy and multiple signals using nonelectric coupling such as a magnetic field or light.

The isolation device 198 provides isolated energization on line 208 which is coupled to regulator rectifier 210. Regulator-rectifier 210 provides energization potentials to circuitry on the right side of barrier 170 and may also provide energization to one or more sensors 166. The isolation device 198 provides an output on line 206 which is a clock reference for analog to digital converter (ADC) 212. The output on line 206 is also coupled to filter 214 which extracts modulation data and provides it along line 216 to program characteristics of ADC 212. ADC 212 samples the output of one or more sensors 166 and couples a digital signal representative of the sensed parameters adjusted by the programming along line 218 to driver 220. Driver 220 modulates power drawn by isolation device 198 from driver 192 on the other side of the barrier. The modulation is preferably in the form of a serial digital signal. The isolation device 198 provides this modulation along line 204 to filter 222. Filter 222 coupled the data contained in the power modulation to microcomputer 188 where it is stored as an updated representation of the sensed parameter or parameters.

In FIG. 3, a circuit is shown which can be used in a transmitter such as the transmitter shown in FIG. 2 to couple power and multiple signals across a galvanic barrier using a single isolating device, transformer 250. Transformer 250 includes a primary winding 252 electrically insulated from secondary winding 254 to form a galvanic barrier represented by dashed line 256. Drive transistor 258 is coupled in series with primary winding 252 and resistor 260 across a 10 volt power supply. Oscillating, and preferably sinusoidal current supplied by this arrangement excites the transformer so that it can deliver isolated power at its secondary winding 254. The level of drive is amplitude modulated by a field effect

transistor 262 which has its output coupled in parallel with resistor 260 to vary current level in primary 252.

Secondary winding 254 energizes a regulator circuit comprising rectifier diode 264, filter capacitor 266, resistors 268, 274, zener diode 270, and capacitor 272. The regulator provides a supply potential or power to circuitry on the right side of barrier 256 which corresponds to barrier 170 of FIG. 2. Secondary 254 is coupled through resistor 276 and capacitor 278 to provide a clock reference at the drive frequency of driver 258. Filter 280 is coupled to secondary 254 through rectifier diode 264 and comprises resistors 282 and capacitors 286, 288. Filter 280 provides data at its output which represents the modulation provided by transistor 262. This modulation represents programming constants. A signal representative of sensed parameters is presented in serial digital form on line 290 to FET 292 which is connected in parallel across capacitor 294. Capacitcr 294 is connected in series with secondary winding 254. The arrangement modulates the power drawn from driver 258 with the data representative of sensed parameters. This modulation appears on line 296 which carries the data to a microcomputer such as microcomputer 188 of FIG. 2.

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the scope of the invention as defined by the appended claims.

Claims

1. A transmitter (50,150) providing a transmitter output representing a sensed parameter to a loop (52,152) which energizes the transmitter (50,150), comprising:

   an output circuit (60,188,190,194) receiving the energization from the loop (52,152) and controlling the transmitter output as a function of a sensor data input, the output circuit (60,188,190,194) further generating an oscillating driver output signal including programming data representing programmable instructions;
   a sensor circuit (82,220) generating a clocked sensor data output representing the sensed parameter; and
   a single coupling device (76,198,250) driven by the oscillating driver output signal for energizing the sensor circuit (82,220) and for providing a filtered power supply, the programming data for programming the sensor circuit (82, 220) and a clock reference as a function of the oscillating driver output signal to the sensor circuit (82,220), and providing the sensor data output back to the sensor data input of the output circuit (60,188,190,194), the single coupling device (76,198,250) simultaneously coupling energization, the clock reference, and the programming data from the output circuit (60,188,190,194) to the sensor circuit (82,220) and the sensor data from the sensor circuit to the output circuit (60,188,190,194) across an electrically insulating barrier between the output circuit (60,188,190,194) and the sensor circuit (82,220).

2. The transmitter (50) of claim 1 wherein the sensor circuit (82) comprises:

   a clock recovery circuit (98) for recovering a reference clock signal from the oscillating driver output signal, the reference clock signal having a period based on the period of oscillation of the oscillating driver output signal.

3. The transmitter (50,150) of claim 2 wherein the sensor circuit (82,220) comprises:

   an instruction recovery circuit (86,90,214) for recovering the program instructions from the programming data.

4. The transmitter (50,150) of claim 3 wherein the output circuit (60,188,190,194) comprises:

   a data recovery circuit (110,222) for recovering data representative of the sensed parameter from the parameter signal.

5. The transmitter (50,150) of claim 4 wherein the single coupling device means (76,250) comprises:

   an isolation transformer having a primary winding (74,252) coupled to the output circuit (60,188,190,194) and a secondary winding (75,254) coupled to the sensor circuit (82,220).

6. The transmitter (50,150) of claim 5 wherein the output circuit (60,188,190,194) generates the oscillating driver output signal as an oscillating current through the primary winding (74,252).

7. The transmitter (50,150) of claim 6 wherein the output circuit (60,188,190,194 further comprises) :

   a programming data generator (66,188), for generating the programming data by amplitude modulating the oscillating current through the primary winding (74,252).

8. The transmitter (50,150) of claim 7 wherein the secondary winding (75,254) provides a secondary amplitude modulated oscillating current signal to the sensor circuit (82,220) based on the amplitude modulated oscillating current through the primary winding (74,252), the secondary oscillating current signal having substantially the same period of os-

cillation as the oscillating current through the primary winding (74,252).

9. The transmitter (50) of claim 8 wherein the clock recovery circuit (98) is coupled to the secondary winding (75) and recovers the reference clock signal corresponding to the period of the secondary oscillating current signal.

10. The transmitter (50) of claim 9 wherein the instruction recovery circuit (86,90) is coupled to the secondary winding (75) and recovers the program instructions from the programming data based on the amplitude modulation of the oscillating current through the primary winding (74).

11. The transmitter (50) of claim 5 wherein the sensor circuit (82, 220) comprises:
a parameter signal generator circuit, coupled to the secondary winding (75,254), for generating the parameter signal by modulating the voltage across the secondary winding (75,254) based on the sensed parameter.

12. The transmitter (50,150) of claim 11 wherein the data recovery circuit (110,222) recovers data representative of the sensed parameter from the parameter signal based on the modulation of the voltage across the secondary winding (75,254).

Patentansprüche

1. Ein Meßwertgeber (50, 150), der ein Meßwertgeber-Ausgangssignal, das einen erfaßten Parameter wiedergibt, einer Schleife (52, 152) zuführt, die den Meßwertgeber (50, 150) erregt, der folgendes aufweist:

   einen Ausgangsschaltkreis (60, 188, 190, 194), der die Erregung von der Schleife (52, 152) aufnimmt und das Meßwertgeber-Ausgangssignal als eine Funktion eines Sensordaten-Eingangssignals steuert, wobei der Ausgangs-Schaltkreis (60, 188, 190, 194) weiterhin ein oszillierendes Treiber-Ausgangssignal erzeugt, das Programmierdaten enthält, die programmierbare Befehle wiedergeben;

   ein Sensor-Schaltkreis (82, 220), der ein getaktetes Sensordaten-Ausgangssignal erzeugt, das den erfaßten Parameter wiedergibt; und

   ein einziges Schaltgerät (76, 198, 250), das durch das oszillierende Treiber-Ausgangssignal angetrieben wird, um den Sensor-Schaltkreis (82, 220) zu erregen und dem Sensor-Schaltkreis (82, 220) eine gefilterte Stromversorgung, die Programmierdaten zum Programmieren des Sensor-Schaltkreises (82, 220) und ein Takt-Bezugssignal als eine Funktion des oszillierenden Treiber-Ausgangssignals zuzuführen, und das das Sensordaten-Ausgangssignal zurück zum Sensordaten-Eingang des Ausgangs-Schaltkreises (60, 188, 190, 194) führt, wobei das einzige Schaltgerät (76, 198, 250) gleichzeitig die Erregung, das Takt-Bezugssignal und die Programmierdaten vom Ausgangs-Schaltkreis (60, 188, 190, 194) zum Sensor-Schaltkreis (82, 220) und die Sensordaten vom Sensor-Schaltkreis zum Ausgangs-Schaltkreis (60, 188, 190, 194) über eine elektrisch isolierende Schranke zwischen dem Ausgangs-Schaltkreis ((60, 188, 190, 194) und dem Sensor-Schaltkreis ((82, 220) leitet.

2. Meßwertgeber (50) nach Anspruch 1, dadurch gekennzeichnet, daß der Sensor-Schaltkreis (82) folgendes aufweist:
einen Takt-Wiederherstellungs-Schaltkreis (98) zur Wiederherstellung eines Bezugs-Taktsignals aus dem oszillierenden Treiber-Ausgangssignal, wobei das Bezugs-Taktsignal eine Periode aufweist, die auf der Schwingungsperiode des oszillierenden Treiber-Ausgangssignal basiert.

3. Meßwertgeber (50, 150) nach Anspruch 2, dadurch gekennzeichnet, daß der Sensor-Schaltkreis (82, 220) folgendes aufweist:
einen Befehls-Wiederherstellungs-Schaltkreis (86, 90, 214) zur Wiederherstellung der Programmbefehle aus den Programmierdaten.

4. Meßwertgeber (50, 150) nach Anspruch 3, dadurch gekennzeichnet, daß der Ausgangs-Schaltkreis (60, 188, 190, 194) folgendes aufweist:
einen Daten-Wiederherstellungs-Schaltkreis (110, 222) zur Wiederherstellung von den erfaßten Parameter wiedergebenden Daten aus dem Parametersignal.

5. Meßwertgeber (50, 150) nach Anspruch 4, dadurch gekennzeichnet, daß die einzige Schaltgerätvorrichtung (76, 250) folgendes aufweist:
einen Isoliertransformator, der eine Primärwicklung (74, 252), die mit dem Ausgangs-Schaltkreis (60, 188, 190, 194) verbunden ist, und eine Sekundärwicklung (75, 254) aufweist, die mit dem Sensor-Schaltkreis (82, 220) verbunden ist.

6. Meßwertgeber (50, 150) nach Anspruch 5, dadurch gekennzeichnet, daß der Ausgangs-Schaltkreis (60, 188, 190, 194) das oszillierende Treiber-Ausgangssignal als einen oszillierenden Strom durch die Primärwicklung (74, 252) erzeugt.

7. Meßwertgeber (50, 150) nach Anspruch 6, dadurch gekennzeichnet, daß der Ausgangs-Schaltkreis (60, 188, 190, 194) weiterhin folgendes aufweist:
eine Programmierdaten-Erzeugungsvorrichtung (66, 188) zur Erzeugung der Programmierdaten durch Amplitudenmodulation des oszillierenden Stroms durch die Primärwicklung (74, 252).

8. Meßwertgeber (50, 150) nach Anspruch 7, dadurch gekennzeichnet, daß die Sekundärwicklung (75, 254) dem Sensor-Schaltkreis (82, 220) basierend auf dem amplitudenmodulierten oszillierenden Strom durch die Primärwicklung (74, 252) ein sekundäres amplitudenmoduliertes oszillierendes Stromsignal zuführt, wobei das sekundäre oszillierende Stromsignal im wesentlichen dieselbe Schwingungsperiode wie der oszillierende Strom durch die Primärwicklung (74, 252) aufweist.

9. Meßwertgeber (50) nach Anspruch 8, dadurch gekennzeichnet, daß der Takt-Wiederherstellungs-Schaltkreis (98) mit der Sekundärwicklung (75) verbunden ist und das Bezugs-Taktsignal entsprechend der Periode des sekundären oszillierenden Stromsignals wiederherstellt.

10. Meßwertgeber (50) nach Anspruch 9, dadurch gekennzeichnet, daß der Befehls-Wiederherstellungs-Schaltkreis (86, 90) mit der Sekundärwicklung (75) verbunden ist und basierend auf der Amplitudenmodulation des oszillierenden Stroms durch die Primärwicklung (74) die Programmbefehle aus den Programmierdaten wiederherstellt.

11. Meßwertgeber (50) nach Anspruch 5, dadurch gekennzeichnet, daß der Sensor-Schaltkreis (82, 220) folgendes aufweist:
einen Parametersignal-Erzeugungsschaltkreis, der mit der Sekundärwicklung (75, 254) zur Erzeugung des Parametersignals durch Modulieren der Spannung über die Sekundärwicklung (75, 254) basierend auf dem erfaßten Parameter verbunden ist.

12. Meßwertgeber (50, 150) nach Anspruch 11, dadurch gekennzeichnet, daß der Daten-Wiederherstellungs-Schaltkreis (110, 222) Daten, die den erfaßten Parameter wiedergeben, aus dem Parametersignal basierend auf der Modulation der Spannung über die Sekundärwicklung (75, 254) wiederherstellt.

Revendications

1. Transmetteur (50, 150) fournissant un signal de sortie de transmetteur, représentant un paramètre détecté, à une boucle (52, 152) excitant le transmetteur (50, 150), transmetteur qui comprend :
un circuit de sortie (60, 188, 190, 194) recevant l'excitation de la boucle (52, 152) et régulant le signal de sortie de transmetteur en fonction d'une entrée de données de capteur, le circuit de sortie (60, 188, 190, 194) produisant en outre un signal de sortie oscillant de l'étage d'attaque, qui comprend des données de programmation représentant des instructions programmables ;
un circuit de capteur (82, 220) produisant un signal de sortie de données de capteur synchronisé, représentant le paramètre détecté ; et
un dispositif de couplage simple (76, 198, 250) commandé par le signal de sortie oscillant de l'étage d'attaque, pour exciter le circuit de capteur (82, 220) et pour fournir une alimentation électrique filtrée, les données de programmation permettant de programmer le circuit de capteur (82, 220) et un signal d'horloge de référence en fonction du signal de sortie oscillant de l'étage d'attaque allant vers le circuit de capteur (82, 220), et de renvoyer le signal de sortie des données de capteur à l'entrée de données de capteur du circuit de sortie (60, 188, 190, 194), le dispositif de couplage simple (76, 198, 250) couplant simultanément l'excitation, le signal d'horloge de référence, et les données de programmation provenant du circuit de sortie (60, 188, 190, 194) au circuit de capteur (82, 220), et les données de capteur provenant du circuit de capteur au circuit de sortie (60, 188, 190, 194), à travers une barrière d'isolation électrique disposée entre le circuit de sortie (60, 188, 190, 194) et le circuit de capteur (82, 220).

2. Transmetteur (50) selon la revendication 1, dans lequel le circuit de capteur (82) comprend :
un circuit de récupération de signal d'horloge (98) pour récupérer un signal d'horloge de référence à partir du signal de sortie oscillant de l'étage d'attaque, le signal d'horloge de référence ayant une période qui dépend de la période d'oscillation du signal de sortie oscillant de l'étage d'attaque.

3. Transmetteur (50, 150) selon la revendication 2, dans lequel le circuit de capteur (82, 220) comprend :
un circuit de récupération d'instructions (86, 90, 214) pour récupérer les instructions de programme à partir des données de programmation.

4. Transmetteur (50, 150) selon la revendication 3, dans lequel le circuit de sortie (60, 188, 190, 194) comprend :
un circuit de récupération de données (110, 222) pour récupérer des données représentative du

paramètre détecté, à partir du signal de paramètre.

5. Transmetteur (50, 150) selon la revendication 4, dans lequel les moyens formant dispositif de couplage simple (76, 250) comprennent :

un transformateur d'isolement ayant un enroulement primaire (74, 252) couplé au circuit de sortie (60, 188, 190, 194) et un enroulement secondaire (75, 254) couplé au circuit de capteur (82, 220).

6. Transmetteur (50, 150) selon la revendication 5, dans lequel le circuit de sortie (60, 188, 190, 194) produit le signal de sortie oscillant de l'étage d'attaque sous forme d'un courant oscillant qui traverse l'enroulement primaire (74, 252).

7. Transmetteur (50, 150) selon la revendication 6, dans lequel le circuit de sortie (60, 188, 190, 194) comprend en outre :

un générateur de données de programmation (66, 188) pour produire les données de programmation par modulation d'amplitude du courant oscillant qui traverse l'enroulement primaire (74, 252) .

8. Transmetteur (50, 150) selon la revendication 7, dans lequel l'enroulement secondaire (75, 254) fournit au circuit de capteur (82, 220) un signal de courant oscillant secondaire modulé en amplitude, en fonction du courant oscillant modulé en amplitude qui traverse l'enroulement primaire (74, 252), le signal de courant oscillant secondaire ayant essentiellement la même période d'oscillation que le courant oscillant qui traverse l'enroulement primaire (74, 252) .

9. Transmetteur (50) selon la revendication 8, dans lequel le circuit de récupération de signal d'horloge (98) est couplé à l'enroulement secondaire (75) et récupère le signal d'horloge de référence correspondant à la période du signal de courant oscillant secondaire.

10. Transmetteur (50) selon la revendication 9, dans lequel le circuit de récupération d'instructions (86, 90) est couplé à l'enroulement secondaire (75) et récupère les instructions de programme à partir des données de programmation, sur la base de la modulation en amplitude du courant oscillant qui traverse l'enroulement primaire (74).

11. Transmetteur (50) selon la revendication 5, dans lequel le circuit de capteur (82, 220) comprend :

un circuit générateur de signal de paramètre, couplé à l'enroulement secondaire (75, 254), pour produire le signal de paramètre, en fonction du paramètre détecté, par modulation de la tension aux bornes de l'enroulement secondaire (75, 254).

12. Transmetteur (50, 150) selon la revendication 11, dans lequel le circuit de récupération de données (110, 222) récupère des données représentatives du paramètre détecté à partir du signal de paramètre, sur la base de la modulation de la tension aux bornes de l'enroulement secondaire (75, 254).

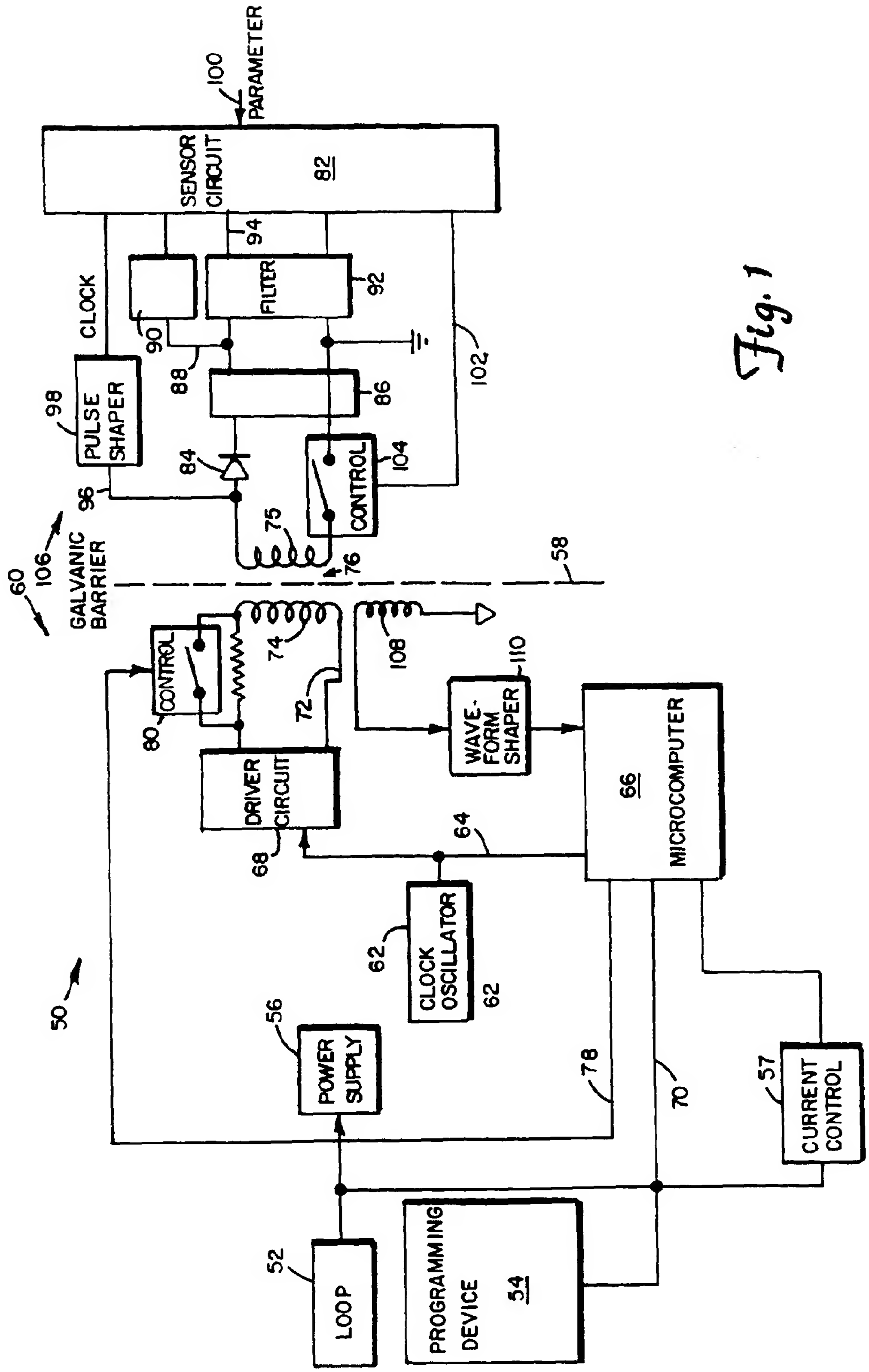
SENSOR CIRCUIT
82
PARAMETER
100
FILTER
92
94
90
88
86
CLOCK
PULSE SHAPER
98
96
84
75
76
CONTROL
104
102
60
106
GALVANIC BARRIER
58
CONTROL
80
74
72
108
110
WAVE-FORM SHAPER
MICROCOMPUTER
66
DRIVER CIRCUIT
68
64
CLOCK OSCILLATOR
62
50
POWER SUPPLY
56
78
70
CURRENT CONTROL
57
LOOP
52
PROGRAMMING DEVICE
54

Fig. 1

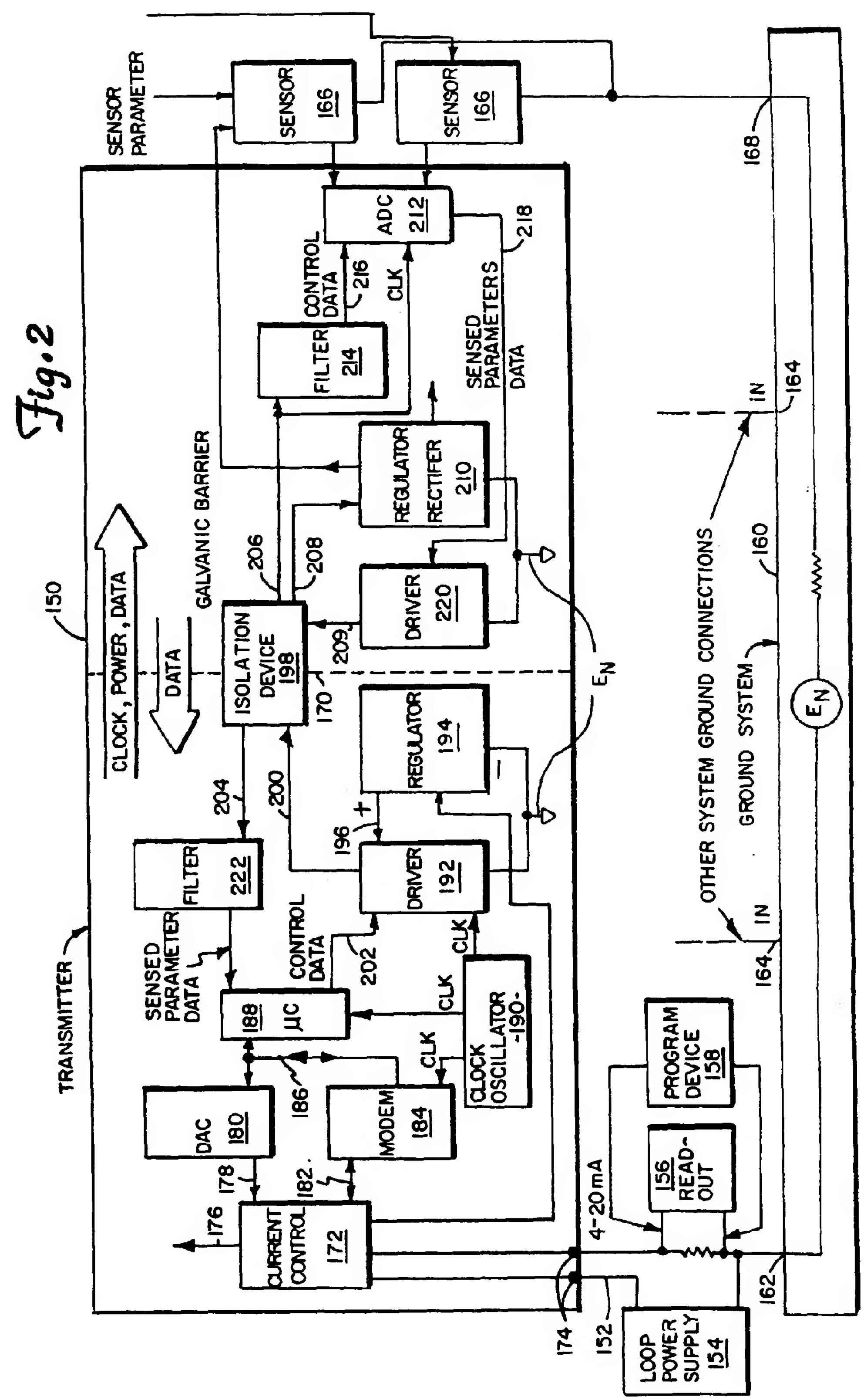
Fig. 2
TRANSMITTER
150
CLOCK, POWER, DATA
DATA
GALVANIC BARRIER
SENSOR PARAMETER
SENSOR 166
SENSOR 166
ADC 212
CONTROL DATA
216
CLK
218
FILTER 214
SENSED PARAMETERS DATA
REGULATOR RECTIFER 210
206
208
ISOLATION DEVICE 198
209
170
DRIVER 220
REGULATOR 194
EN
204
200
196
DRIVER 192
FILTER 222
SENSED PARAMETER DATA
CONTROL DATA
202
CLK
188 μC
CLK
CLK
CLOCK OSCILLATOR -190-
DAC 180
MODEM 184
186
178
182
176
CURRENT CONTROL 172
174
152
4-20mA
LOOP POWER SUPPLY 154
156 READ-OUT
PROGRAM DEVICE 158
168
IN
164
OTHER SYSTEM GROUND CONNECTIONS
160
GROUND SYSTEM
IN
164
162

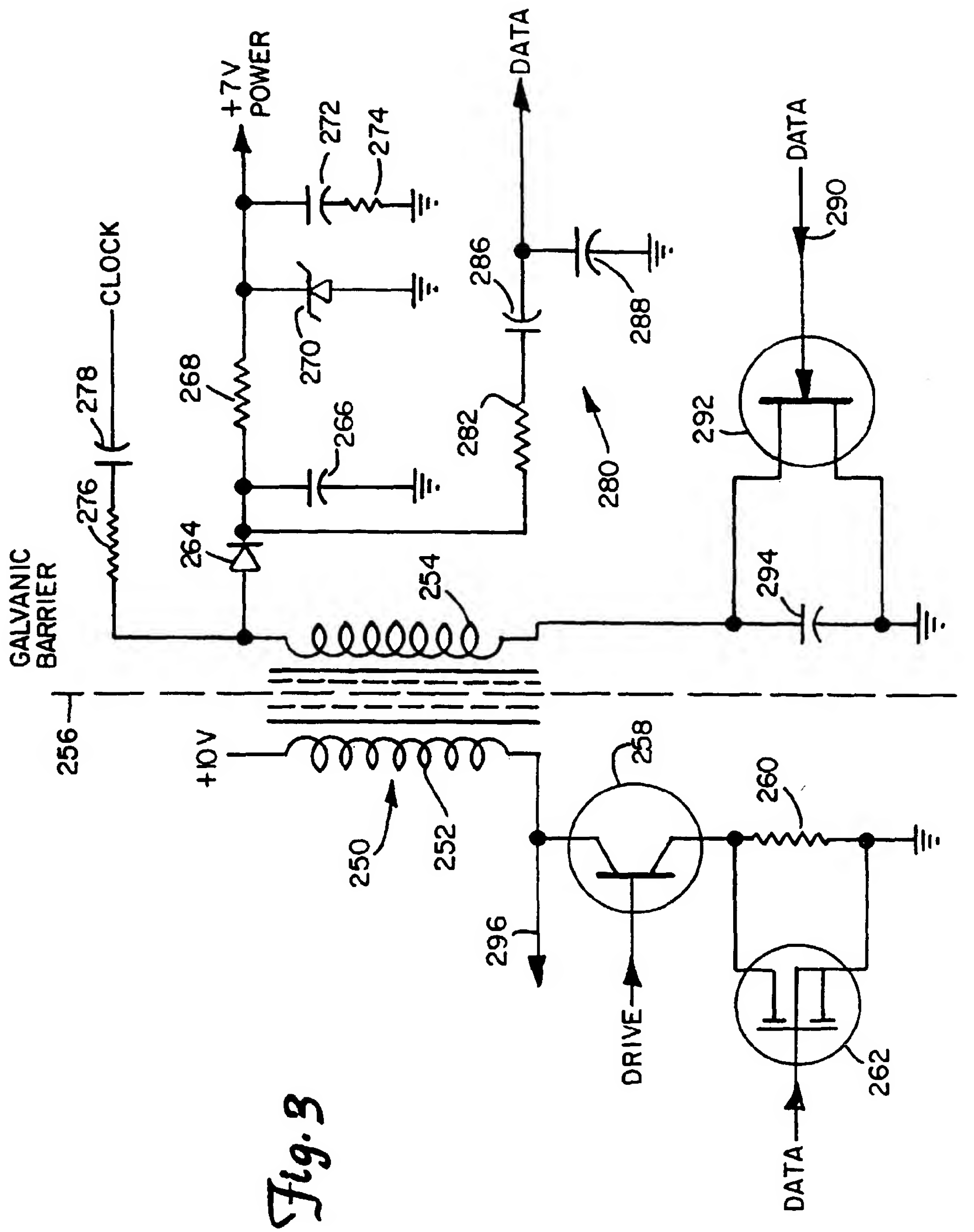
GALVANIC
BARRIER
256
+10V
250
252
254
258
260
262
264
266
268
270
272
274
276
278
280
282
286
288
290
292
294
296
CLOCK
+7V
POWER
DATA
DATA
DRIVE
DATA

Fig. 3